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STUDY ON MECHANICAL PROPERTIES OF CARBON NANOTUBES AND ITS APPLICATIONS

Brunda H P[1], Diya Nachappa [1], R Varun[1], Rhea Lewis[1], Dr M N Gururaja[2]
[1]UG Students , [2]Associate Professor
Department of Mechanical Engineering
Dayananda Sagar Academy Of Technology And Management
Karnataka , Bangalore

ABSTRACT

Nanoscience and designing gives crucial opportunity to specialists to figure on properties of materials at a nuclear or sub-atomic level. Carbon Nanotubes [CNT] grows superior execution, multifunctional, high strength, pliable, break free, solid and shows propitious job in improving the attributes of arranged ordinary materials. Carbon nanotubes [CNT] have a decent fluctuate of utilization in substance, clinical, material science and designing application. a few examination works are finished on mechanical, synthetic, electrical properties and applied at exploratory and field levels. This survey paper frames the mechanical properties of Carbon Nanotubes [CNT].

KEYWORDS: Nanotechnology, Carbon Nanotubes [CNT], Mechanical properties

INTRODUCTION

The term "nanotechnology," also abbreviated "nanotech," refers to the utilization of materials at the atomic, molecular, and supramolecular scale for industrial purposes. The size of greater scales from around 1mm to 100mm is known as the nano scale. Science in engineering is facilitating technique that enables the development of materials with better characteristics between 1 and 100 microns in the United States. The development of materials with improved properties is made possible in the United States of America thanks to engineering science [1]. The 1990s saw the beginning of the development of nanotechnology with the invention of the laurel winning process, scanning, tunnelling, and atomic force research. These methods made it possible to handle physical matter at extremely small scales and create this image.

CARBON NANOTUBES [CNT]

Carbon nanotubes (CNTs) are molecular carbon allotropes with cylinder-like structures that are made of rolled graphene layers. When utilized as an addition, various carbon allotropes grant materials certain qualities, and these attributes vary greatly from one type of carbon to another depending on their origin, shape, and production method. Depending on whether they consist of a single printed symbol wall (SWCNTs) or several walls arranged concentrically, there are two types of CNTs (MWCNTs,).

SINGLE-WALLED NANOTUBES (SWNT)

(SWCNTs), also known as "graphene nano tubes" (GNTs). SWCNTs are often manufactured in factories using the arc discharge process. The wall of the carbon nanotube is made up of just one layer of graphene, which is the most important characteristic that sets SWCNTs apart. In other words, single-walled carbon nanotubes are frequently described as seamless rolls of graphene that form hollow cylinders. The variation in SWCNT diameter is almost negligible. 7 to 2mm and an 8nm-long bundle, respectively.

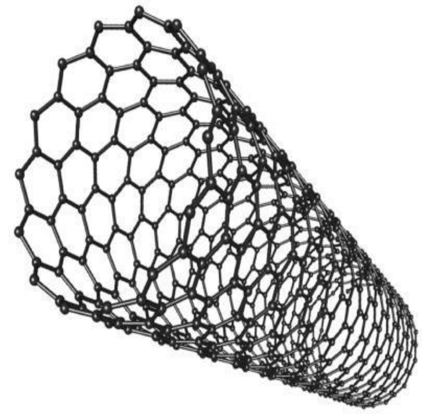

Fig 1.1 : Single-walled nanotubes

MULTI-WALLED NANOTUBES (MWNT)

A multi-walled nanotube is thought of as a smooth roll-up of many layers of graphene into a tube form, or as a concentrical arrangement of single-walled carbon nanotubes (SWCNTs). MWCNTs are typically manufactured in factories using the thermal chemical vapor deposition (CVD) technology [3][4] and don't require any specialized fabrication techniques. MWCNTs will have tens to hundreds of walls, with an average distance between neighboring walls of 0.34 nm.

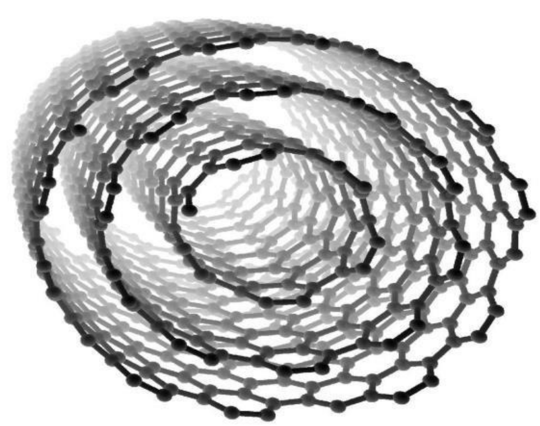

Fig 1.2:Multi-walled nanotubes

2.LITERATURE SURVEY

Amit Kumar et al [2] indicated that graphene has more strength than carbon nanotubes (CNTs) due to its surface's wrinkled pattern, which is brought about by a high density of surface imperfections and benefits from more contact with polymer than a CNT that has been rolled up. This study compares the various mechanical properties of carbon nanotube (CNT) with graphene using data from experiments and analyses. The attachment of Cnt to graphene was found to demonstrate greater load transfer capabilities between the filler and polymer-matrix interface. Applications for this exist in micro, nano, and nanoelectromechanical systems (MEMS and NEMS)

Anjibabu Merneedi et al [3] it was stated that carbon nanotubes are recognized as a superior form of carbon. When compared to the competing fibers on the market, these have better mechanical and chemical qualities. High-strength fibers are frequently used in extremely short, factory-made, and composite applications to meet demanding requirements. These composites will fulfil the strength requirements of structural and nonfunctional components in a very broad range of sectors. Due to their excellent strength-to-weight quantitative ratio and light weight, these composites are frequently used in a wide range of applications. A variety of compound matrices are employed, and nanotube/ceramic and nanotube/metal composites are improving. In the end, it may be said that a composite phenolic resin with two entirely distinct twin towers of multiwalled nanotubes was successful. The composite with the highest CNT content has the best mechanical characteristics of the bunch.

Lhaj El Hachemi Omari et al [4] highlighted that thermoplastic polymers and natural fibers supported bio-composites have recently been used in turbine blades to replace non-biodegradable materials. In addition, carbon nanofillers like graphene nanoplatelets (GNPs) and carbon nanotubes (CNTs) are being used to improve the mechanical performance of composites. In this work, the effective matrix was used with similar alfa and E-glass fibers for the second blend whereas the Mori-Tanaka technique was used for the primary blend of a chemical compound matrix supported by CNT and value nanofillers. The goal is to determine how the quantity fraction and ratio AR of nanofillers affect the composite's elastic characteristics**.** Additionally , Young's modulus will rise and Poisson's quantitative relation will fall as the quantity fraction and ratio of nanofillers rise. Additionally, the composites had improved mechanical properties in both transverse and longitudinal orientations for chemical compounds reinforced with GNP and CNT, respectively. This study could compare different mix strategies as well as the effectiveness of synthetic and natural materials utilized to make turbine blades. Alpha and E-glass composites with reinforced PP and UP polymers that contain

CNT and GNP were studied using mechanical and analytical techniques. On the mechanical properties of nanocomposites, the impact of volume fraction, ratio, and orientation was highlighted. It has been demonstrated that the inclusions' shape and orientation, particularly for extremely large volume fractions and side ratios, will significantly affect the mechanical-elastic properties.

S.P. Harshaa et al [5] explained that explained that due to their superior mechanical, thermal, and electrical properties to the simplest carbon fibers, carbon nanotubes (CNTs) have attracted interest from the composites community to investigate the possibility of using them as an additional reinforcement in carbon fiber-bolstered chemical compound composites. This study use finite element analysis and mixture theory rules to investigate the impact of CNT reinforcement on the coefficient of elasticity of a two-section chemical compound composite that already exists. Using a 3D produced volume component, the mechanical characteristics of CNT-bolstered nanocomposites are investigated. The carbon nanotubes are modelled as a time hollow cylindrical form elastic material. The primary reinforcements are carbon and glass fibers, while epoxy and PEEK are used as the matrix materials. Different CNT volume fractions, as well as different fiber and matrix arrangements, are evaluated for their mechanical properties. Elastic modulus has been observed to significantly increase when there is a low volume proportion of CNT. Additionally, experimental results are compared to the results of CNT reinforcement on epoxy-carbon fiber. The analysis clearly demonstrates that CNT plays a substantial role in enhancing the mechanical properties of chemical compound-based composite materials, whose manufacturing process is already well known. A three-section chemical compound composite with a modest volume percentage of CNT will surely be able to be employed in part by UAVs and other structural applications, despite escalating consistency and process concerns making the massive volume fraction of CNT troublesome.

Wing Kam Liu a et al [6] said that over the past ten years, there has been a significant advancement in nanoscale science and technology. Carbon nanotubes (CNT), one of the most interesting nanomaterials, have attracted significant attention in terms of basic property measurements and possible applications. This is frequently mostly due to the amazing physical properties that have been found via both theoretical and experimental studies. For instance, mechanical deformation could be used to adjust the electrical characteristics of CNT. Such characteristics are quite interesting for applications like sensors or high-quality materials. Numerous scientific and technical disciplines are involved in the multidisciplinary research of those features. Numerous scientific and technical disciplines are involved in the multidisciplinary research of those features. The investigation of the mechanical characteristics and possible uses of two types of CNTs—single-walled carbon nanotubes (SWCNT) and multi-walled carbon nanotubes—has made steady progress (MWCNT). One layer of a multiwalled nanotube will have a measured specific tensile strength that is up to 100 times greater than that of steel, making the graphene sheet (in-plane) as rigid as diamond under low strain. These mechanical characteristics spur more research towards practical uses for strong, lightweight materials. Recent reports indicate a significant improvement in mechanical properties for composite materials enhanced by either SWCNT or MWCNT.

L.Zuppiroli et al [7] stated that there are currently many great experimental results available on the quick discovery of the elastic properties of carbon nanotubes. The methods of high-resolution transmission research microscopy (HRTEM) and atomic force microscopy are typically used to determine the Young's moduli of single-wall fullerene bundles and multi-walled nanotubes, which are manufactured in a variety of ways (AFM). The conclusion that carbon nanotubes have exceptional strength, flexibility, and resilience is supported by these findings. This study describes the most important recent developments in theory and practice, as well as how they relate to the properties of nanotubes within the broader field of materials science. It also emphasizes the role played by our analytical cluster. A fuller understanding of the connection between the structural order of the nanotubes and their mechanical characteristics would be necessary for the creation of composite materials based on carbon nanotubes. According to the results of our inquiry so far, there is a qualitative relationship between a fullerene's Young's modulus and the level of disorder in the walls' atomic structure. Other exciting research indicates that carbon nanotubes' remarkable mechanical properties can be used to benefit composite materials, but that the key remaining challenge of load transfer potency must be resolved before acceptable engineering materials can be created.

Bansri Jethwa et al [1] demonstrated how engineers may engineer the qualities of materials by working at the atomic or molecular level thanks to nanoscience and nanotechnology. It has greatly increased the mechanical, physical, and chemical properties of the materials in addition to making it easier to go beyond many of the restrictions of conventional materials. Carbon nanotubes (CNTs) show promise in modifying/improving the properties of the traditional building materials, such as concrete and steel, in order to generate high performance, multipurpose, ideal (high strength, ductile, fracture free, durable) construction materials. The study gives a quick introduction to nanotechnology, carbon nanotubes, their use in numerous fields, and the characteristics, potential applications, and research findings of various CNT researchers. Additionally, it compares carbon nanotubes to other nanomaterials. Studying the impact of CNTs on various qualities, including porosity, electrical conductivity, compressive strength, tensile strength, modulus of elasticity, and flexural strength, revealed that the construction sector first adopted CNTs because of their excellent mechanical properties. Their unique size, stiffness, strength, and durability have generated a great deal of interest in the pharmacy community. There are two types of nanotubes: those with one wall and those with many walls. A variety of methods, such as arc discharge, optical device ablation, chemical vapor deposition, isotonic solution methodology, and flame synthesis methodology, are being developed to produce nanotubes in significant quantities.

Shruti et al [8] a cylinder-shaped carbon allotrope known as a carbon nanotube (CNT) that has uses in applied science, physical science, optics, and several fields of fabric science and technology. In this article, we'll focus specifically on the types of carbon nanotubes—single-walled, multiwalled, and double-walled ones—as well as their remarkable physical characteristics, including thermal phenomena, mechanical and electrical properties, etc., and practical uses. The underlying structural component of carbon nanotubes, graphene, is also described. An example of a microbial fuel cell is one in which bacteria use soluble waste, such as sugar, flour, and alcohol, to produce energy and clean water. The method makes it possible to cleanse home or industrial sewage while obtaining electricity. Because of its high area, sensible mechanical qualities, and chemical stability, CNTs are well suited for designing the electrodes for microbial fuel cells. Nanotubes are utilized to create high energy density batteries and centrifuge plates, which have the potential to store more energy than their conventional equivalents.

Shivani Mehta et al [9]- The effect of Multiwall Carbon Nanotubes (MWCNT) on the compressive strength of mortar is discussed in this research. Sonication is used to complete the MWCNT and cement dispersion process. The MWCNT is permanently dispersed with cement using the same amount of surfactants. By increasing the amount of cement by 0.75 nada MWCNT, the compressive strength increases. According to the results, the MWCNT mortar combination's compressive strength after seven days is comparable to that after twenty-eight days for a normal mortar combine. Even as a semiconductive material, carbon nanotubes can be employed to potentially make mortar that has a sensing quality. Its is well known that MWCNT mortar has more strength compared to conventional mortar and that MWCNT mortar also has the capacity to transmit electricity. Possessing a complete dispersion of MWCNT into cement particles is essential for sensible conduction. Chemical agent with atomic number 11 lignosulphonates is reasonable and easily accessible, and it has reasonable solubility in water.

P. Anvesh et al [10] indicated that a wide range of automotive businesses are currently using nanomaterials. These Nano materials are playing a significant role across many industries. These Nano elements are employed as reinforcing materials in the production of vehicles, particularly in the automobile industry. They are useful for many engineering applications because of their exceptional electrical, mechanical, optical, thermal, and chemical properties. This study discusses many techniques for producing carbon nanotubes and describes each one's advantages. The purpose of this work is to review and analyses the use of carbon nanotubes in automotive products while outlining their synthesis, qualities, and uses. In order to increase the fuel efficiency of the vehicle, carbon nanotubes are used in cars and all other automotive vehicles, particularly in the field of the fuel element system. In order to develop products, carbon nanotubes are used in a variety of industries. In the automotive industry, they are mostly used to produce spare parts and components that boost the fabric's tensile strength and stability. reduces fabric load loss and makes the car lighter to increase the vehicle's fuel efficiency.

3.LITERATURE GAP

Single walled nanotubes (SWNT) are mixed with epoxy and glass fiber to form a laminated sheet with varying the SWNT's percentage.

Table 3.1 Composition table

SWNT	1-3%
EPOXY	39-55%
GLASS FIBER	55-63%

Young's modulus, tensile strength, percentage of elongation, bending, and hardness are tested on the produced laminated sheets. Single walled carbon nanotube applications are discovered based on the values obtained.

CONCLUSION

A brief examination of the mechanical characteristics of CNTs and linked structures was done. Because of the relevance of CNT materials and their high predicted strength, recognized high stiffness in tensile stress, and rarity, their mechanical properties can undoubtedly be closely examined for many years. It has been demonstrated that three section polymers composite with low volume fraction of CNT have potential in part, UAVs, and different structure analysis. Numerical analysis supported time mechanics approach is used to examine the CNTs. The development of replicable CNT composites that fully use the exceptional mechanical capabilities of CNTs will depend on the correlation of strength with disorder. Experiments are currently being conducted to confirm the tremendous strength, exceptional flexibility, and resilience of CNTs that were predicted on paper.

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